DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention about a simulated defect sample and the sensitivity detecting
method of a defect inspection device, In particular, an inspected object is irradiated with inspection light,
photoelectric conversion of this inspection light with which it irradiated is carried out by a photoelectric
conversion means, and it is related with the sensitivity detecting method using the simulated defect
sample and this which are used for the defect inspection device which inspects the defect of an inspected
object based on the output signal of this photoelectric conversion means.
[0002]
[Description of the Prior Art]Irradiate inspected objects, such as a web it is running, with optical beams,
such as laser, and the transmitted light or catoptric light is entered in an electric eye, The device by
which various kinds of defects which exist in a web are evaluated based on the photoelectric conversion
output from an electric eye is provided (for example, JP,59-220636,A, JP,6-207910,A).
[0003]The normal light light-receiving method which the defect inspection device of such a web enters
only normal light in an electric eye through a slit shape sensor window, and detects a defect by the
output change, Normal light is covered with a mask and it is divided roughly into two sorts of an
extraordinary light light-receiving method which enter only extraordinary light in an electric eye and
detect a defect according to the output increase. The former method is an effective inspection system,
when dirt, a foreign matter, and a defect (concentration defect) that gives a concentration change to an
optical beam still like a pinhole exist in the inspected object.
The latter method is an effective inspection system, when a defect over which an optical beam is
scattered exists in the inspected object like a foreign matter without a crack and a color.

[0004]
[Problem(s) to be Solved by the Invention]In such a defect inspection device, in order to check the
sensitivity of test equipment, the method of arranging a real defect to a scanning position, measuring an
inspection waveform with an oscilloscope etc., and measuring S/N and a signal level is taken. However,
the shape of a real defect is not uniform, and the sample which has a real defect in actual work is made
to go up and down delicately in a scanning position, and it has a place where a signal level becomes the
maximum, and is considered as the signal level of the defect, and there is a problem that the alignment
takes time and effort. Also in selection of a real defect, there is a problem that it is necessary to look for

the defect out of which the signal level near [in a actual inspection] a threshold comes, the guarantee which emits a standard signal level does not necessarily have the defect moreover looked for, it becomes trial-and-error work, and an efficient sensitivity check becomes difficult.

[0005]This invention is for solving an aforementioned problem.
The purpose is to provide the simulated defect sample which enabled it to detect the sensitivity of a defect inspection device simply and efficiently, and the sensitivity detecting method of a defect inspection device.

[0006]
[Means for Solving the Problem]To achieve the above objects, in the invention according to claim 1. Irradiate an inspected object with inspection light and photoelectric conversion of this inspection light with which it irradiated is carried out by a photoelectric conversion means, It is a simulated defect sample used for detection of sensitivity of a defect inspection device which inspects a defect of an inspected object based on an output signal of this photoelectric conversion means, and the almost same output as said defect is provided with a linear simulated defect acquired from said photoelectric conversion means. It is preferred that said linear simulated defect inclines and is arranged to a scanning direction of said inspection light. Light which carried out scattered reflection by a defect which exists in the surface or an inside of said inspected object is received by said photoelectric conversion means, Said defect inspection device is constituted so that a defect of an inspected object may be detected based on an output signal of this photoelectric conversion means, and it is preferred to form said linear simulated defect with a laser marking device. Said simulated defect is estranged to a scanning direction of said inspection light, and are formed, and, as for these simulated defects, it is preferred to be constituted so that outputs from said photoelectric conversion means may differ. [two or more]

[0007]In a method of detecting sensitivity of a defect inspection device which irradiates an inspected object with inspection light, carries out photoelectric conversion of this inspection light with which it irradiated by a photoelectric conversion means, and inspects a defect of an inspected object in the invention according to claim 5 based on an output signal of this photoelectric conversion means, Using a simulated defect sample which formed in a line a simulated defect acquired from said photoelectric conversion means, the almost same output as said defect made an irradiation position of inspection light incline to a scanning direction of said inspection light, and has arranged said linear simulated defect, and sensitivity is detected based on a detecting signal of said simulated defect.

[0008]
[Embodiment of the Invention]Drawing 1 is a perspective view showing the simulated defect sample and laser marking device of this invention. The simulated defect sample 10 is the laser marking device 12, forms the straight line shape simulated defect 13 in the base member 11 of the same construction material as the web as an inspected object, and is constituted. What does not contain a defect among webs is used as the base member 11, and it is formed in rectangular shape.

[0009]as for the linear simulated defect 13, the angle of gradient theta turns into 45 degrees to the long side 11a of the base member 11 -- as -- the base member 11 -- it is mostly formed in the center section. The length of this simulated defect 13 is 50 mm, and width is 0.1 mm. The channel depth of the simulated defect 13 is formed to such an extent that the almost same output as the typical defect of the inspected object 11 is obtained from the photodetector 15 explained later, and it is preferably used in 0.04-0.06 mm. This channel depth can be changed by changing the laser output of the laser marking

device 12, and scan speed, or performing marking to multiplex.

[0010]As shown in drawing 2 and drawing 3, the simulated defect sample 10 is attached to the inspection position 21 of the web which is an inspected object of the defect inspection device 20. At this time, the simulated defect 13 is attached so that the angle of gradient theta may be about 45 degrees to the scan line (scanning locus) 22 of the optical beam 26. Since it is formed to the long side 11a of the simulated defect sample 10 of rectangular shape so that the simulated defect 13 may incline at the angle which is 45 degrees beforehand, the simulated defect 13 can be set to a scanning position by doubling the long side 11a of the sample 10 in parallel with the scan line 22. And since the simulated defect 13 has a certain amount of length, it can be easily arranged so that the simulated defect 13 may intersect the scan line 22.

[0011]Although the angle of gradient theta to the scan line 22 of the simulated defect 13 should just be except parallel or a rectangular cross, the range of 25 to 65 degrees is preferably good, and the range of 35 to 55 degrees is more preferably good. The simulated defect 13 may be formed in parallel to the long side 11a, and in this case, when it attaches the simulated defect sample 10 to the scanning position 21, it is positioned so that the simulated defect 13 may incline to the scan line 22.

[0012]Drawing 2 is a schematic diagram showing the defect inspection device 20. The scanner 22 comprises the laser oscillator 23, the polygon mirror 24, and the photosensor 25. The laser beam 23a emitted from the laser oscillator 23 becomes the prescribed diameter 26, for example, a 0.33-mm optical beam, on the web (not shown) as an inspected object which carries out a continuous run in the direction of figure Nakaya seal X, or the surface of the simulated defect sample 10. Although drawing 2 shows the example which has arranged the simulated defect sample 10 as an inspected object to the scanning position of the optical beam 26, when using as a defect inspection device, the web as an inspected object is arranged in the scanning position of the optical beam 26. And it is reflected by the polygon mirror 24 which carries out a high velocity revolution clockwise, and the optical beam 26 scans the inspected object 10, for example, a simulated defect sample, crosswise by it. The photosensor 25 receives the optical beam 26, just before the optical beam 26 scans an inspected object, and it outputs the reference point passing signal used as the standard of inspection width setting out.

[0013]In order to receive the optical beam 26 which penetrated the inspected object, the photodetector 30 is used so that the scan line 22 of the optical beam 26 may be met. As shown in drawing 3, in the center section, the band-like mask plate 31 is arranged along the scan line 22 by the sensor window 30a of the photodetector 30. When an inspected object does not have defects, such as a crack, the light which penetrated the inspected object goes straight on as it is, it hits the mask plate 31 of the photodetector 30, inspection light does not reach the sensor window 30a, and the output level of the photodetector 30 becomes below a predetermined value.

[0014]On the other hand, if an inspected object has a defect, in this portion, inspection light is refracted, will carry out scattered reflection and will be distributed. For this reason, inspection light goes into the sensor window 30a of not only the mask plate 31 but that upper part and a lower part, and inspection light reaches the light guide stick in the photodetector 30. In the photodetector 30, the cylindrical lens, the light guide stick, and the dispersion belt are arranged, and the photo detector 32 is formed in both ends. And it is collected with a cylindrical lens, and the laser beam included in the sensor window 20a passes a light guide stick, it enters into a dispersion belt and is reflected. A part of lights reflected with the dispersion belt are transmitted to the end face with a light guide stick, and go into the photo detector 32.

[0015]The photoelectric conversion signal of the photo detector 32 is sent to the defect signal generating part 35, signal processing is carried out here, and a single-engined defect signal is outputted. First, the photo detector 32 which received the laser beam outputs the photoelectric conversion signal corresponding to the light volume of a laser beam, respectively, and supplies these to AGC circuit (automatic gain control circuit) 40. When this AGC circuit 40 scans the optical beam 26 to the normal inspected object which the photoelectric conversion signal from each photo detector 32 is added, and also does not have a defect and that inspection light is entered in the photodetector 15, Irrespective of the position of the scanning center line, a photoelectric conversion signal is amplified so that an output signal may be set to a constant level. Even if the power change by degradation of the laser oscillator 3 etc. breaks out, it is compensated in above-mentioned AGC circuit 20. The gain-adjustment knob is provided in AGC circuit 40, and change of a gain value is attained by operation of this knob. A change of a gain value is made by the sensitivity management etc. which are explained later.

[0016]The signal from AGC circuit 40 is inputted into the filter circuit 41 containing a band pass filter. The filter circuit 41 removes the low frequency wave and high frequency noise signal on which the signal is overlapped, and outputs the signal to the binarization circuit 42. The binarization circuit 42 carries out binarization of the signal with a threshold. Thereby, binarization of the signal is carried out to the defect signal which becomes high-level when a signal level becomes below a threshold, and the normal signal which serves as a low level when other. And the evaluation signal which consists of these signals is inputted into AND circuit 43.

[0017]On the other hand, the photosensor 25 outputs a reference point passing signal to fixed timing before the scan start of an optical beam, and this reference point passing signal is inputted into the inspection width setting circuit 44. The inspection width setting circuit 44 outputs the inspection width signal which becomes high-level for every rain width on the basis of said reference point passing signal based on the inspection width data and the lane number which are beforehand set up corresponding to the width dimension of an inspected object. And AND circuit 45 will be in a gate open condition with this inspection width signal. Therefore, when a defect signal appears during the period whose inspection width signal is high-level, a defect signal is outputted from AND circuit 45. A lane divides 1 time of a scan line into plurality.

[0018]Thus, the acquired defect signal is sent to the error data processing unit 50. In the error data processing unit 50, a defect position is pinpointed based on the above-mentioned single-engined defect signal. the case where the continuity of a single-engined defect signal is judged and a single-engined defect signal carries out prescribed frequency continuation -- these groups -- an extensive field defect is specified based on a single-engined defect signal. The single-engined defect and extensive field defect which were these-detected, and its position information are sent to the defect image processing unit 51, and are displayed on the display, and also they are memorized by the memory 50a in the error data processing unit 50, and various data processing is performed. And defect information by which data processing was carried out is referred to at the time of product processing of a film etc., and it is used so that a various defect may not be included in a final product. It is used also as the cause pursuit of a defect, or feedback information of a production line. The defect image is picturized, based on said defect and its position information, each defect and its picture may be made to correspond and these defects and the picture of those may be displayed on said display.

[0019]In performing sensitivity management of a defect inspection device, a simulated defect sample is attached to a scanning position, a simulated defect output signal is acquired like the time of inspecting a

defect, and it manages sensitivity. It is carried out also when this sensitivity management is performed periodically, and also defects occur frequently, and judging whether defects' actually occurring frequently by the inspected object side or the test equipment side has a cause.

[0020]In this sensitivity management, the output wave of the filter circuit 41 in drawing 2 is first observed with an oscilloscope. When the waveform from the filter circuit 41 is higher than initial setting, sensitivity will be high as a whole. When it is lower than initial setting, sensitivity will be low as a whole. When sensitivity has change, AGC circuit 40 is functioning normally, or it checks whether the beam diameter of the laser beam 23a is normal, or there is not any dirt in the photodetector 20, and suitable correspondence is carried out, and it resets so that the output wave from the filter circuit 41 may become the same as initial setting.

[0021]Conditioning of a defect inspection device is performed as follows, and is used effectively. The width of an inspected object is wide, and in installing a surface inspection machine and two photodetectors crosswise, if sensitivity differences are between these two sets, a guarantee-of-quality level will not become uniform. In this case, the same simulated defect sample 10 is installed in each, and AGC circuit 40 is set up so that the output wave from the filter circuit 41 may become equal. When there is a line of two lines or more which manufactures the same variety, it must avoid that guarantee-of-quality levels differ with each line. In this case, the above-mentioned sensitivity management is first performed to the inspection machine which serves as a standard using the simulated defect sample 10. Next, the output wave from the filter circuit 41 is observed using the same simulated defect sample 10 to the inspection machine for conditioning, and AGC circuit 40 is set up so that this waveform may become equal to the thing of the inspection machine used as a standard. Hereafter, conditioning of the inspection machine of other lines is carried out in a similar manner.

[0022]Although a laser beam is scanned and the defect signal was acquired by receiving this transmitted light with a photodetector at the above-mentioned embodiment, A defect signal may use a false defect sample also to a defect inspection device which is obtained in addition to this with the method using line CCD etc. which are indicated by JP,2000-9659,A, for example. This invention may be carried out not only to the transmitted light of a web but to the defect inspection device of the type which acquires a defect signal from catoptric light.

[0023]Although the one simulated defect 13 was formed and the simulated defect sample 10 was constituted from an above-mentioned embodiment, two or more simulated defects may be established. Drawing 6 estranges and puts the five simulated defects 60-64 in order to the scanning direction of a laser beam, and the embodiment which constituted the simulated defect sample 65 is shown. In this case, that width, a channel depth, the shape of a quirk, etc. are changed, and each simulated defects 60-64 are constituted, and are made into the simulated defect corresponding to a typical defect so that the outputs from said photodetector 20 may differ. The identifier showing a simulated defect may be written together to this simulated defect.

[0024]Although the angle of gradient of each simulated defect is fixed in drawing 6, it may replace with this, and as shown in drawing 7 and drawing 8, the angle of gradient of each simulated defects 71-78 may be changed. The angle of gradient is changed, the simulated defects 71-74 of the same standard are arranged, and it comprises the simulated defect sample 70 shown in drawing 7. in the simulated defect sample 80 shown in drawing 8, the angle of gradient was changed and that to which the width and the channel depth of each simulated defects 75-78, the shape of a quirk, etc. were changed like drawing 6

has been arranged -- it is constituted. By using the simulated defect samples 65, 70, and 80 which have two or more of these kinds of simulated defects, also to the defect of a different classification, a simulated defect sample can be set at once and sensitivity detection etc. are attained efficiently.

[0025]Although this invention was carried out to the false defect which inspection light distributes in the above-mentioned embodiment, the marking apparatus, for example, the ink-jet printer etc., of common knowledge of the false defect corresponding to this concentration defect even if it is cases, such as a concentration defect, etc. -- a line -- and the false defect sample corresponding to a concentration defect etc. may be similarly created with constituting so that it may be inclined and arranged in a scanning direction.

[0026]

[Effect of the Invention]According to this invention, since the almost same output as a defect was provided with the linear simulated defect acquired from a photoelectric conversion means, the always fixed output signal will be acquired simply and a check, conditioning, etc. of sensitivity can be performed efficiently. A real defect is set to a scanning position in a scanning position, and it becomes unnecessary in particular, to carry out alignment or to set this in search of what is considered for a real defect to be the optimal.

[0027]Attachment becomes possible easily, without requiring the fixing position of a simulated defect sample strictly, since a linear simulated defect inclines to the scanning direction of said inspection light and was arranged. Since a false defect is made to incline to a scanning direction and it arranges, it is avoided that the inspection light which passed the false defect diffuses in a scanning direction, and is not detected with a defect, and it can detect a false defect certainly.

[0028]The light which carried out scattered reflection by the defect which exists in the surface or the inside of an inspected object is received by a photoelectric conversion means, When the defect inspection device is constituted so that the defect of an inspected object may be detected based on the output signal of this photoelectric conversion means, It becomes possible to create a uniform simulated defect stably by forming a linear simulated defect with a laser marking device, and also many same simulated defect samples can be created. Thereby, detection of sensitivity, etc. can be performed with sufficient accuracy. By estranging a simulated defect to the scanning direction of inspection light, forming them, and constituting these simulated defects so that the outputs from said photoelectric conversion means may differ, sensitivity detection etc. can be performed to two or more kinds of defects with one simulated defect sample, and working efficiency improves. [two or more]

[0029]The almost same output as a defect uses the simulated defect sample which formed in the line the simulated defect acquired from said photoelectric conversion means, Since the irradiation position of inspection light is made to incline to the scanning direction of said inspection light, a linear simulated defect is arranged and sensitivity was detected based on the detecting signal of a simulated defect, sensitivity detection can be performed simply and easily.

[Translation done.]